ISSD NEWSLETTER

Volume I Number 1 January 1988

Note From the Editor:

I am pleased to submit to you the first edition of the **ISSD** newsletter. A great deal of work has gone into its publication. At the present time we are planning to publish the newsletter every other month so you can expect the next newsletter in early March. You will note that this newsletter has a "featured frog", namely Phyllobates terribilis. This particular specie was chosen mainly because there is great interest in it among American herpetologists even though it is poorly represented in American collections. Here is an example of where the Americans have much to learn from the Europeans who have many years of experience keeping and breeding this interesting animal. Phylllobates terribilis is also of interest because of its potent toxicity. We are privileged to have in this edition a paper by Helmut Zimmermann of Stuttgart, West Germany, whose expertise in the keeping and breeding of this specie is well documented in his many scholarly publications. We are indebted to him for his willingness to share with us his knowledge.

It is my expectation that the newsletter will improve with each new issue. Work is underway at this time on the March edition. We intend to keep the "featured frog" format and the featured frog of the March issue will be Dendrobates auratus. This frog is of interest to us because it is currently being bred extensively and it is one of the more available species. It is also the only Dendrobatid that has been successfully introduced into a non-native environment, although we use the term successfully with certain reservations. You can expect to learn something of the history of the introduction of this animal into the Hawaiian islands in the next edition.

It has taken nearly a year from the initial effort to organize **ISSD** to the publication of this first newsletter. While I am pleased to have taken this first important step, I am at the same time anxious to press on toward the goal of firmly establishing **ISSD** as a viable entity. It is a common phenomenon in organizations such as **ISSD** to have roughly eighty-five percent of the membership be rather "inactive". We need to do better than that! Those who can author papers for publication should contact me, I need your help! People with organizational skills are needed to work on a number of important projects. If you think you can be of assistance and you would like to get in on the ground floor, NOW is the time. Please take another look at the Call to Service page that was in your information packet and let me know where you would like to help. There is one thing that every member can do, and that is to encourage his or her colleagues to join. There are many who have taken a wait-n-see attitude towards **ISSD**, some of these people have great potential for valuable contribution to the work of the society. We encourage those of you who are members to urge others to join.

I hope you find this newsletter informative and enjoyable; your comments, criticisms, praises, or questions are welcome.

Reproductive Behavior and Breeding of the Dart-Poison Frog Phyllobates terrilibis

Helmut Zimmermann & Elke Zimmermann

Zusammenfassung

Der neotropische Pfeilgiftfrosch Phyllobates terribilis wurde von den Autoren von der F1- bis F4-Generation nachgezuchtet. Das Werbeverhalten wurde anhand einer Reaktionskette dargestellt und die dabei auftretenden Rufe anhand von Computerspektrogramme. Die fur Dendrobatiden relativ einfache From der Brutpflege sowie Methoden einer erfolgreichen Aufzucht der Kaulquappen und der Jungfrosche wurden beschrieben.

The diurnal dart-poison frog **Phyllobates terribilis**, from the tropical rain forests of South-Western Colombia, is the most toxic among all dendrobatids. The Indians of the Choco region prepare their blowgun darts with the skin secretions of this frog specie. It consists of batrachotoxin and some other compounds in lessor amounts, less than 200 ug of which would be fatal for humans if it were to reach the bloodstream through an open wound. (Myers, Daly & Malkin 1978). Only 50% of the skin toxin detected in wild caught frogs remains after one year of captivity. In captive bred specimens the skin toxin cannot be detected at all. In the keeping of this specie in terrariums for many years (F1- to the F4-generation) we have not noticed any toxic effect. Maintenance and breeding of these frogs is relatively easy (Zimmermann 1986). They should be offered a humid terrarium with a small water basin and plants. Small crickets, fruit flies, and other similarly small insects suffice as food. Under these conditions our frogs have reached an age, at the time of the writing of this paper, of six years, and they still show reproductive activity.

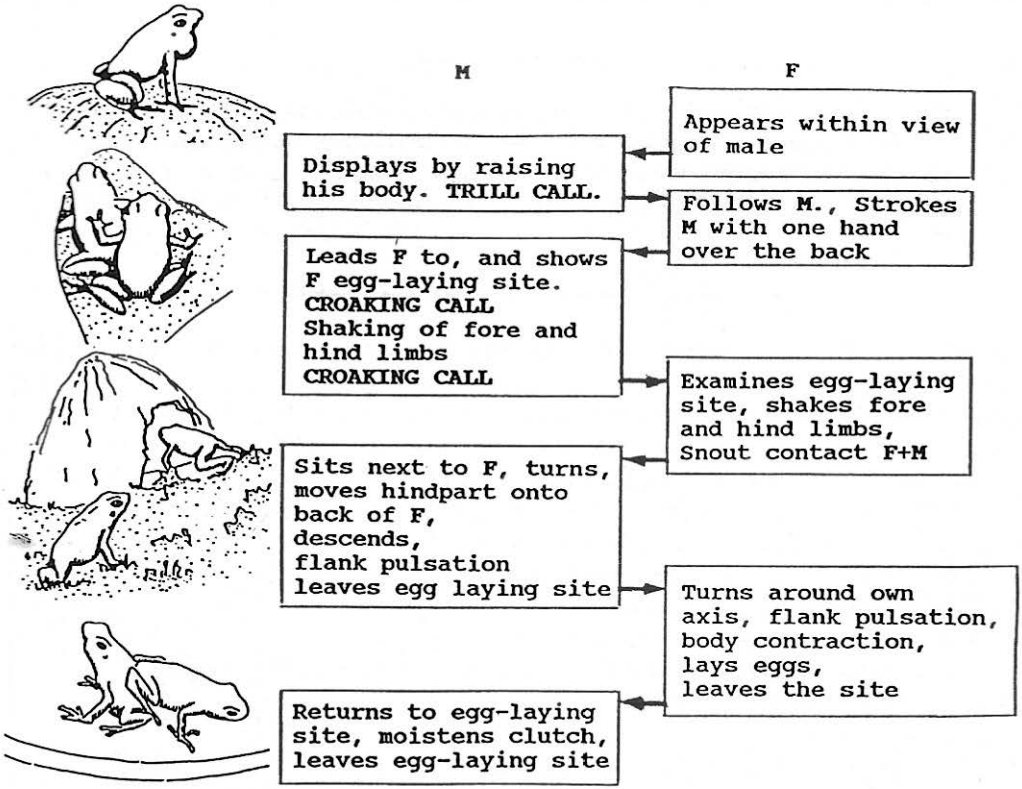
Figure 1

Terrarium suited to the needs of frogs from tropical rain forests. (from Tropical Frogs by Helmut Zimmermann, 1979, T.F.H. Publications, Inc. Ltd., New York. 93 pp.

Courtship

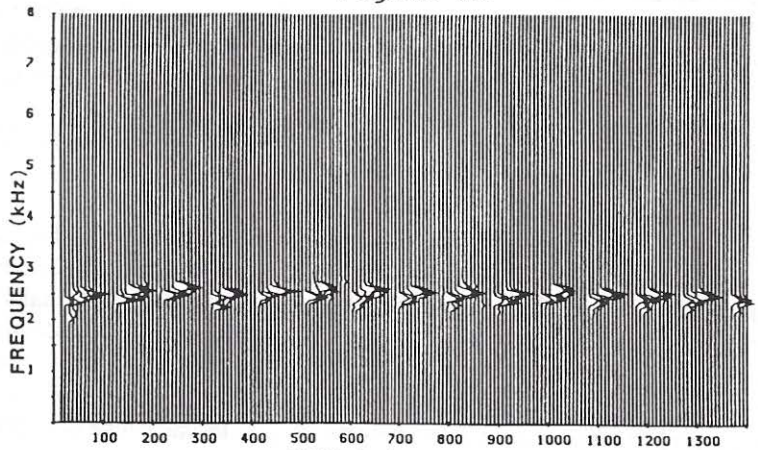
If you intend to establish a breeding colony you should keep one or two males together with three or four females in a terrarium sized 50cm x 50cm x 40cm (20"x20"x16") (Zimmermann & Zimmermann 1987). Females will stimulate reproductive activity in each

Figure 2. Sequential chain of actions in the courtship and oviposition of Phyllobates terrilibis



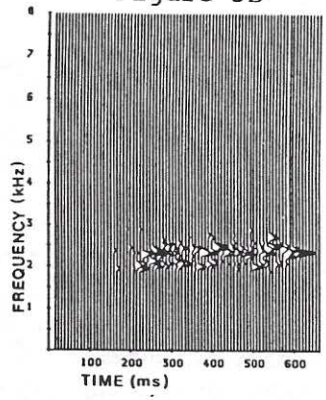
other, this leads to synchronous oviposition. In figure 2. a typical courtship sequence is illustrated. As soon as a breeding male detects a gravid female, he produces a trill call. This is the characteristic call for attracting females from large distances (figure 3A). This evokes a so-called phonotactic response in the female, who approaches the male and will follow him. She signals her egg-laying motivation and her further interest in the male by stroking his back alternatively with one hand. The male, then, emits a croaking call (figure 3B) and will show her a potential oviposition site. During this courtship ceremony it may happen that another gravid female will interfere by jumping on the back of the courting female, pressing her towards the ground. This is an aggressive act which resembles the cephalic amplexus practiced by other dendrobatid species (Zimmermann & Zimmermann 1985). However, in most cases the aggressive female will

Figure 3A



Computer spectrogram of a typical trill call of a 34 mm *P. terribilis* male (recorded at 25° C). A part of the 2,4 s is shown. Frequency resolution 62,5 Hz.

Figure 3B



Computer spectrogram of a typical croaking call of a 34 mm *P. terribilis* male (recorded at 25° C). Frequency resolution 62,5 Hz.

Fig 4. Larval transport of Phyllobates terrilibis in small groups from clutch to water.

deliver and both of them will court the male. Reaching a suitable egg-laying site (humid dead leaves or a plastic cup containing a small amount of water, a covered and protected site being preferred) the male slides his hindpart upon the back of the female and remains in that position for several minutes. He then descends and leaves the site. Slowly sliding her hindpart on the ground in a circular movement, the female deposits her eggs, approximately seven in younger females, but up to as many as twenty-three in older ones.

Brood Care

Parental care in Phyllobates terribilis is performed exclusively by the male. He visits the clutch one or two times after oviposition to moisten it. This is sufficient under natural conditions since in their native habitats, very high humidity occurs throughout the year. Normally there is more than five meters of rainfall annually. In the terrarium we care for the clutch by sprinkling the entire terrarium once a day to maintain the necessary high humidity. Approximately two weeks after oviposition (egg development is dependant upon temperature, 22 degrees - 25 degrees C [72 degrees - 77 degrees F] in our terrariums) the fully developed larvae break from the egg jelly. At this time the male returns to the clutch and positions himself so that he is sitting in the midst of it. As soon as the tadpoles recognize his movement they display a high locomotor activity. They them wriggle over his shanks onto his back where they settle down by sucking it tightly (figure 4). The father transports them during the following hours, on his back, to a nearby water hole. As soon as the tadpoles come in contact with the water they loose their hold and swim into the water. Often the father will make several repeat trips in order to transport the entire clutch to the water. No further brood care is practiced after this transport is accomplished.

Rearing of Tadpoles and Froglets

Better success in rearing tadpoles is experienced if they are removed from the terrarium. The tadpoles should be placed in small plastic or glass containers filled with water up to a depth of five centimeters. A group of fifteen tadpoles will require a container approximately 20cm x 35cm x 10cm (8" x 14" x 4"). The tadpoles are omnivorous, they can be fed pieces of beefheart, algae, aquatic plants, and dry fish food. The water should be changed twice per week. When the tadpoles have attained a size of about 14mm (.55"), and have developed fore and hind limbs, we remove them from the water filled containers and place them in a small plastic terrarium lined with moistened foam or cotton rags.We also provide plant leaves for hiding places. The tail of the tiny froglet is resorbed within one week. At this time they begin to feed on fruit flies or baby crickets. Food must be supplemented by dusting with vitamins to prevent the development of rachitis (rickets). The young frogs will reach sexual maturity at an age of approximately eighteen months.

Literature Cited

MYERS, C.W.; DALY, J.W.; & Malkin, B. (1978): A Dangerously Toxic Frog (Phyllobates) used by

Embera Indians of Western Colombia, with Discussion of Blowgun Fabrication and Dart Poisoning. - Bull. Am. Mus. Nat. Hist., New York, 161(2): 311-365.

ZIMMERMANN, E. (1986): Breeding Terrarium Animals. - T.F.H. Publications, Inc. Ltd., New York, 384 pp.

ZIMMERMANN, H. & E. ZIMMERMANN (1985): Zur Fortpflanzungsstrategie des Pfeilgiftfrosches Phyllobates terribilis MYERS, DALY & MALKIN, 1978.- Salamandra 21(4) : 281-297.

--(1987): Mindestanforderungen fur eine artgerechte Haltung einiger tropischer Anurenarten.- Z. Kolner Zoo, 30(2) : 61-71.

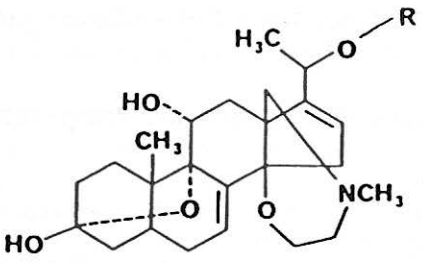
A DISCUSSION OF THE TOXICITY OF PHYLLOBATES TERRIBILIS

by dale bertram, m.d.

Phyllobates terribilis is the "featured frog" of this edition of the newsletter. It is one of only three frogs to which the term **Dart-Poison Frog** can properly be applied. The toxic skin secretions of P. terribilis and two other frogs (P. bicolor and P. aurotaenia) have been used by various South American Indian groups for purposes of poisoning blow gun darts. Before proceeding to the topic of its toxicology, it is worthwhile to discuss briefly the controversy over the terms **Poison-Arrow Frog** and **Dart-Poison Frog.**

Most people who have an interest in frogs have heard the term **Poison-Arrow Frog** as it is commonly misapplied to the entire family of Dendrobatid frogs. It is not too difficult to understand why this term has come to enjoy widespread popularity. The keeping and breeding of amphibians is a relatively new science. It is a widely held misconception that amphibians are difficult to maintain and breed in captivity. Many amateur herpetologists are reluctant to attempt to keep them, even if they have great interest in their biology. Dendrobatids have long been a popular subject of hobby related herpetological books because of their stunning beauty and photogenic nature. As a result of the misconceptions about their purported delicate dispositions, interest in them is often limited to what can be gleaned from these popular books. They also happen to be fairly difficult to obtain. Rarely are they seen offered for sale in pet stores, and when they are the price is usually quite high. Beauty, relative unavailability, and a perceived delicate nature

all add up to an aura of the exotic. Add to this visions of Indians lurking in dark and mysterious jungles waiting to shoot monkeys, missionaries, and other passers-by with darts poisoned by the toxic skin secretions of these beautiful creatures and you have the makings of myth. It is easy to see how a catchy phrase like **Poison-Arrow Frog** sticks in the mind. In the popular literature this term has become synonymous with any coloful Dendrobatid frog.



Structure of the main steroidal ring of the basic batrachotoxin molecule. Substitutions at R yield differing properties and give specific identity to individual alkaloids.

While it may be easy to understand why this term became popular it is not so easy to tell where the term originated in the first place. The Spanish word for dart is *flecha*. If the context in which the word is used is not sufficiently clear to indicate that darts are being discussed, *flecha* will usually be translated *arrow*. While it has been thoroughly documented that frog toxins have been used to poison blow gun darts, there are no accounts of arrows being so treated. It should also be noted that most South American Indian groups that use poison darts actually use plant toxins rather than frog toxins. One of the earliest accounts of the practice of using frogs for poisoning darts was made by C.S. Cochrane in 1825. I think it is worthwhile to quote in part from Cochrane's Travels in Colombia by way of illustration:

"those who use their poison catch the frogs in the woods, and confine them in a hollow cane, where they regularly feed them until they want the poison, when they take one of the unfortunate reptiles and pass a pointed piece of wood down his throat, and out at one of his legs. This torture makes the poor frog perspire very much, especially on the back, which becomes covered with white froth: This is the most powerful poison that he yields, and in this they dip and roll the points of their arrows."

One thing is certain, the term **Poison-Arrow Frog** is a misnomer. Myers and Daly have suggested that the more accurate term **Dart-Poison Frog** be substituted. While this term is indeed more accurate in describing the unusual use to which a few frogs have been put, I think it should likewise be discarded. The reason that I suggest this change is as follows. As it is currently misused, **"Poison-Arrow Frog"** is synonymous with all dendrobatid frogs. A similarly broad application is likely to be made for any new term that would be substituted. Because of prolonged use the term is firmly entrenched and any opportunity to restrict a new generic term to that small group of frogs to which it properly applies has been lost. If we try to encourage the use of this new term what is likely to happen is that one misnomer will be replaced by another. Unless it is perfectly clear in context that one of the few species that has actually been utilized in this practice is

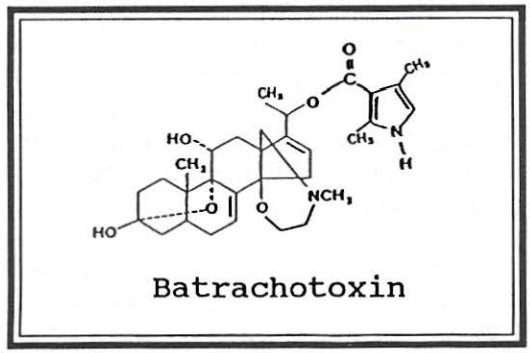
being discussed, I think it would be better to stick to the more general term **Dendrobatid Frog**. Although this is certainly not as catchy a phrase, it is also not one predisposed to be used in broader application than was originally intended.

I will not detail the process whereby toxins are extracted from P. terribilis for purposes of poisoning blow gun darts. The reader is referred to the excellent monograph entitled A Dangerously Toxic New Frog (Phyllobates) Used by Embera Indians of Western Colombia, with Discussion of Blowgun Fabrication and Dart Poisoning by Myers, Daly, & Malkin. If you do not have a copy of this important work you are well advised to obtain one and specific information on how to do so can be found in the postscript of this paper.

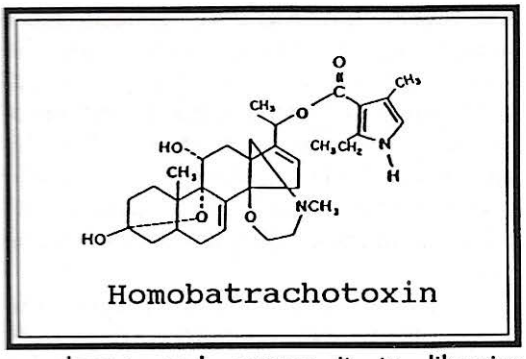
Toxicity of skin secretions is certainly not limited to Dendrobatids. It is the rule rather than the exception among amphibians. However, it is the extraordinary potency of the terribilis toxins that warrants their being singled out for discussion. The major skin toxins of P. terribilis, the batrachotoxins, are essentially neuromuscular toxins. Their effects result from interference with the maintenance of cell membrane electrical polarization. A discussion of how they effect the function of muscle and nerve cells is best preceded by a brief and simplified overview of the physiology of these tissues.

Nerve and muscle tissues are electrically active tissues, the function of which is dependent upon control of transmembrane ion gradients. Cell membranes are semipermeable to certain electrically charged ions, principally sodium (Na+) and potassium (K+). In the normal state there is a disparity between intracellular and extracellular fluid ion concentrations. This state is maintained by active, energy consuming, mechanisms. The extracellular Na+ concentration is high relative to the intracellular Na+ concentration. Those sodium ions that do diffuse across the membrane are actively "pumped" out. Maintenance of a high concentration of positively charged sodium ions in the extracellular fluid holds the cell membrane in an electrically polarized state. In this manner, cell membranes function as electrochemical capacitors.

One of the most important properties of cells is their ability to alter membrane permeability. Under the appropriate stimulus the relative impermeability of cell membranes to Na+ can be rapidly reversed. When this occurs there is a massive influx of Na+ resulting in depolarization of the cell; in effect the "capacitor" is discharged. Cell membrane depolarization does not occur everywhere at once over the entire surface of the cell, but rather is initiated in one place and spreads from there in a controlled fashion. In this manner the propagation of a wave of depolarization serves as a communication mechanism along the surface of the cell and also between cells. For example, a depolarization wave initiated in the membrane of the cell body of a motor neuron in the brain can be transmitted down a very long cell process to a motor end plate on the surface of a muscle cell. Depolarization of the nerve cell motor end plate results in the release of a chemical neurotransmitter (acetylcholine) which diffuses across to the muscle cell



Batrachotoxin

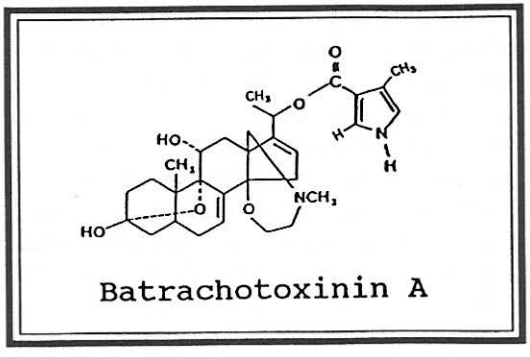


Homobatrachotoxin

membrane and causes it to likewise depolarize. The manner in which the muscle cell membrane depolarizes in response to acetylcholine is especially germane to this discussion. Acetylcholine has the ability to bind chemically with specific receptor sites on the muscle cell surface in such a way that they are physically altered. This physical alteration results in opening of the Na+ channels. The membrane is no longer able to exclude Na+. As it comes pouring in, the muscle cell membrane is depolarized. Depolarization of the muscle cell membrane initiates a complex series of events that results in contraction of the muscle. The action of acetylcholine is terminated by acetylcholinesterase, which is present in high concentration at the motor end-plate. When all the acetylcholine is broken down, the selective **im**permeability of the cell membrane is restored, and the cell repolarizes by pumping out the Na+.

Drugs which interact with the acetylcholine receptor cause muscle paralysis. Whether the paralysis is spastic or flaccid depends on how the substance interacts with the receptor. One such drug is curare, which binds to the receptors in a reversible manner. Curare is the principle ingredient in most South American Indian blow-gun dart poisons. Curare has the ability to bind the acetylcholine receptors in such a way that they are unresponsive to acetylcholine and are essentially locked in the closed channel phase. The result is that the signal cannot be passed from nerve cell to muscle cell. Although they remain polarized, they cannot contract. Other compounds exist which can interact with the receptors in an **irreversible** manner. Batrachotoxins differ from curare in this respect. The also differ from curare in the way in which they interact with the acetylcholine receptor. . Batrachotoxins have the effect of opening the sodium channels and holding them open. The result is a sustained depolarization that cannot be reversed.

The effect of sustained membrane depolarization differs depending upon which tissue is effected. In skeletal muscle there is spastic paralysis. If those muscles involved in breathing are effected, asphyxiation results. If heart muscle is effected, the heart will not be able to function mechanically as a pump, heart failure is the result. Batrachotoxins also poison nerve tissue. Sustained depolarization results in an inability to transmit neuronal impulses. Generalized tonic/clonic seizure activity can result. If the electrical conduction system of the heart is affected abnormal rhythms of the heart can be generated which will be incompatible with rhythmic contraction of the heart muscle, complete cardiopulmonary arrest follows. For obvious reasons, the effect of these toxins on humans has not been scientifically tested. However, some data



Batrachotoxinin A

exists from experiments conducted on mice. The really extraordinary significance of the batrachotoxins relates to their incredible potency. Very minuscule amounts of these substances can produce lethal poisoning, they may quite possibly be the **most** potent animal toxins yet known! To quote Myers & Daley: *"In 20-gram white mice, the minimal lethal dose of batrachotoxin-homobatrachotoxin is about 0.05 micrograms when injected subcutaniously. Thus, an individual Phyllobates terribilis, with an average amount (1100 micrograms) of these compounds, contains enough poison to kill upward of 20,000 mice".* No data exists on the minimum lethal dose for humans, but it should be quite obvious that P. terribilis is an exceedingly toxic animal. It is known that the passage of time causes a reduction in the amount of skin toxin produced by each individual frog. After approximately one year in captivity, frogs possess only 50% of the amount of batrachotoxin that they had at the original time of capture. The mechanism of this phenomenon is not known. For reasons which are not well understood, F1 and subsequent generations of captive bred frogs, do not seem to be toxic at all. Anyone attempting to work with wild caught specimens would do well to maintain a healthy respect for their potential toxicity! Precautions should be taken when handling specimens, i.e. rubber gloves should be worn. Myers & Daly mention in their monograph certain anecdotal data concerning the accidental transfer of toxins from hands to face, and also the tasting of secretions from the back of P. vittatus with the tip of the tongue. Those who would be tempted to try any home "experimentation" should be forewarned that there is no antidote! Treatment of batrachotoxin-homobatrachtoxin poisoning would be difficult to say the least. Treatment is limited to supportive care only. I do not think that the average physician would have any idea at all how to proceed in the treatment of poisoning with these compounds. The other **true** Dart-Poison Frogs produce the same toxic compounds, however the quantities produced are considerably less than is the case with P. terribilis. Washing of the hands after handling is an absolute minimum precautionary step when dealing with any Phyllobatid specie.

It has been reported by some that handling of P.terribilis without rubber gloves causes a skin rash. I doubt that such a rash results from batrachotoxins. It is more than likely a contact dermatitis, which is mediated by the body's own immune response and has nothing to do with neuromuscular poisoning.

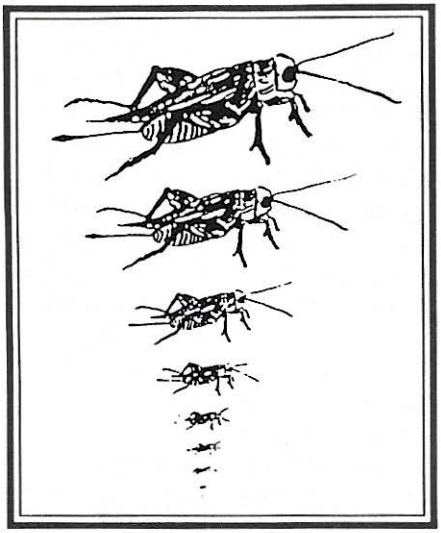
In conclusion I will reiterate the fact that Phyllobates terrilibis not only produces some extraordinarily toxic compounds, it produces them in relatively massive quantities. This habit earns it the distinction of being one of the most poisonous animals on the earth. It should also earn it the respect of those who would try to keep and breed it in captivity.

Postscript:
Copies of the monograph: **A Dangerously Toxic New Frog (Phyllobates) Used by Embera Indians of Western Colombia, with Discussion of Blowgun Fabrication and Dart Poisoning** can be ordered from the American Museum of Natural History. Request, **Bulletin of the American Museum of Natural History,** Volume 161 : Article 2, 1978. Cost is $5.95, plus postage. Address is:

American Museum of Natural History
Central Park West at 79th Street
New York, New York, 10024, U.S.A.

Helpful Hints

In this column we hope to give you a few "helpful hints" in an area where those who would try to keep relatively large numbers of Dendrobatids must experience success. The subject in question is that of generation of a reliable and consistent food supply. Dendrobatids are active animals which require food in abundance. They are restricted to very small insects as prey. Adequate nutrition is especially crucial if breeding is a major goal of the keeper. We use wingless fruit flies, small waxworm maggots, aphids, leaf lice, and occasionally other small insects. While it is good to have variety, it is impossible to sustain a large colony of frogs using these sources. These insects are considered to be good supplements but the mainstay of the diet is baby crickets. Crickets are an ideal food simply because they can be produced in large quantities by methods that are very cost effective in terms of money and effort expended.



We will describe the method which has been very successful for us in the breeding of crickets. We do not claim that this is the only method, or even the best method but it works **well**. That is the best argument we can offer for its use.

We currently maintain a collection of approximately one hundred frogs. More than adequate quantities of crickets are provided for this number of frogs by the following system: Three sets of four tanks, twelve tanks in total, are rotated on a schedule that ensures that as one set is becoming exhausted the next set in series is hatching new baby crickets. The bottom of each ten gallon tank has a layer of approximately five centimeters of fresh damp sand. The tanks have glass tops to prevent evaporation of moisture from the sand. Each tank is provided with two petri dish tops into which has been placed some ground up cat food. We use Feline Growth Food by **Science Diet**. This particular brand was chosen because it grinds up easily to provide a good consistency and moisture content. I am sure that other types of cat or dog food would be just as good. We recommend that a high quality growth food be used. A few pieces of shredded lettuce are also provided. We obtain Brooder crickets from Selph's Cricket Ranch at a cost of $8.50 per five hundred, plus postage. Five hundred Brooders is sufficient to start four cultures. Crickets ordered from Selph's on Monday arrive on Wednesday. We live in Wisconsin so in the winter we ask the post office to hold the package and call us when it comes in.

The five hundred crickets are divided equally among four tanks. Several layers of cardboard egg carton material are put in to increase the surface area. The female crickets begin depositing eggs within a few hours. Female crickets are easily distinguished from males by the long ovipositor that they use to lay eggs deep in the sand. The cricket tanks are

kept in the frog room where the daytime temperature averages 82 degrees F (28 degrees C). After about a week most of the Brooder crickets have died, also the cat food has developed a heavy mold growth, and the egg cartons have begun to deteriorate. At this time the tanks are cleaned in the following manner: The live crickets which remain are removed and set aside. The dead crickets are in a state of partial decay and generally are somewhat stuck to the sand. Using a small paint brush they are gently loosened up along with any other debris present. After this the debris and dead crickets are very carefully removed with a vacuum cleaner (Shop Vac - Wet/Dry), great care being taken not to vacuum up any sand except the very superficial layer that has been loosened by the brush. It is also possible to simply pick out the dead crickets with a tweezers but this takes much more time. The remaining live crickets, minus all but a few of the males, are then put back into the tank. No food or egg cartons are provided. In a day or two all are dead and are removed. While awaiting the hatching of the baby crickets the tank is kept covered with glass in the frog room. At 82 degrees F (28 degrees C) the eggs hatch approximately twenty three days from the time that the Brooders were first put in. Cultures are started every twelve days. Three sets of cultures so timed will result in a constant supply of baby crickets. Temperature is the key factor in the timing. Lowering the temperature by ten degrees F will delay hatching by as much as a week. It should be noted that a consistent cycle is the desired goal. Even if some baby crickets remain when it is time to recycle the tanks they are not saved because it is more important to keep consistency in the schedule.

On or about the twenty-third day, newly hatched crickets can be seen crawling about on the sand. Cat food, lettuce, and fresh egg cartons are reintroduced at this time. Thousands of baby crickets swarm over the underside of the egg cartons. They are easily harvested using the following technique: A small bucket is held inside the tank while the egg carton is lifted over it. Gently tapping the egg carton on the inside edge of the bucket results in the crickets falling into it. Those which try to jump off, and as a result miss the bucket, land back in the tank. With the bucket still held over the tank, the crickets are dumped from it into a small funnel which has a fine mesh screen at its end. We use a strainer that is manufactured to strain urine for kidney stones. These can be purchased in most pharmacies. The cricket filled strainer is set in a clean dry glass bowl and a second strainer held over it. Powdered vitamins are poured into the top strainer and as it is shook the crickets are dusted with the vitamins. Vitamins are prepared in the following manner: A jar of dry, uncoated multiple vitamins are reduced to powder in a food blender. An equal quantity of calcium tablets are similarly reduced to powder and the two preparations mixed. Crickets dusted with the mixture are then fed to the frogs. Over the ensuing twelve days the crickets are harvested. At the proper time the entire set of four tanks are recycled. It should be added that it is best to use fresh sand each time. If this is not done the yield will be greatly diminished with each successive culture. We simply dump the sand into a pile in the back yard, where it is regenerated by the action of the rain and natural biological processes. The same sand is used over and over again without the accumulation of the cricket waste products that tend to retard egg development.

Four tanks so cultured will yield approximately twenty five to thirty thousand baby crickets. If you were to purchase that

many crickets from a cricket ranch the cost would exceed $250.00.

While this system may sound complicated and time consuming as you are reading about it, in actual practice it is quite simple and efficient. It is only the description of it which is laborious. The yield is exceedingly high when compared to the culture of fruit flies or other food insects. It is well worth the effort.

Addendum:
Mention of specific commercial products by name is not an endorsement of that product by **ISSD**. The following information is given solely as a service to the reader and is not an endorsement of Selph's Cricket Ranch by **ISSD**.

Selph's Cricket Ranch
P.O. Box 2123
420 South Front Street
Memphis, Tennessee
38101-2123
Toll Free Call # 800-238-7322

The **12th International Herpetological Symposium On Captive Propagation and Husbandry** will be held in the New York-New Jersey Metropolitan area from June 15th -18th, 1988. Please try to hold those dates open on your calender so that you can attend. Arrangements are being made to hold the first annual meeting of **ISSD** at the symposium. More specific information will be published in the newsletter as it becomes available.

The Breeders Forum

I would like to start a new column in the next newsletter entitled <u>The Breeders Forum</u>. If you have some specific questions that you have not been able to find answers to, this is the place to seek help. If you will submit your short questions to the editor, they will be published in a subsequent edition of the newsletter. Similarly, those who think that they can help with a question that they have read about, can submit an answer to the editor. The answers will also be published in a subsequent edition. In this manner we can "pick each others brains".

I would like to start it off by asking if anyone has any advice on the treatment of intestinal nematode (round worm) infestations in wild caught frogs? I have some wild caught D. pictus from Brazil which have been dying of worm infestations. Shortly before the frogs die, they begin to bloat. After death, large numbers of worms can be seen exiting from both the mouth and the anus. Any advice???

CLASSIFIED ADS

WANTED: Phyllobates terribilis, also any dendrobatid, phyllobatid, or atelopid specie. Call 616-772-4627, Ask for Chris.

FOR SALE: Green & Black Dart Frogs (D. auratus) 1" Wild-Hawaii $15 ea.; Blue & Yellow Dart Frogs (D. tinctorius) 1" CB-West Germany $50 ea.; Yellow & Black Dart Frogs (D. leucomelas) .5" CB-Florida $55 ea.; Strawberry Dart Frogs (D. pumilio) .5" Wild $30 ea.; Yellow Dart Frogs (P. bicolor) CB-Florida $60 ea.
Contact: Andrew Briskin, P.O. Box 560751, Miami, Florida, U.S.A. 33256.

WANTED: Expedition members for field study and non-commercial collection trip to Amazonian Peru, Spring 1989. Company of six sought. Each member must pay his/her own expenses and must secure his/her own collection and export permits (ISSD will assist with this process). Some experience in South American travel helpful. Some knowledge of both Spanish and English very desirable. General goal of expedition is to make field observation of, to photograph, and to collect, all representative species of the quinquevittatus complex. A specific goal and primary objective is to establish a captive population of D. fantasticus for captive breeding. Company membership selection criteria available upon request. Serious inquiries only please!
Contact: Dale Bertram, One Virginia Terrace, Madison, Wisconsin, U.S.A. 53705.

WANTED: P. tricolor 2:3, D. quinquevittatus, D. fantasticus, D. reticulatus, Proven male D. histrionicus (Bullseye pattern-1st choice). Contact: Dale Bertram, One Virginia Terrace, Madison, Wisconsin, U.S.A. 53705, Phone # 608-233-1083